bio-ink based on the expanded cells and the protein, the build process printing the bio-ink in a growth medium mixture, the bio-ink growing into the tissue.

[0010] The organ life support system to maintain and reproduce tissue and/or cells, can include, but is not limited to including, at least one incoming chamber configured to receive an incoming fluid, at least one corresponding effluent chamber configured to allow a fluid outflow from the system, the at least one corresponding effluent chamber further maintained at a pressure different from the at least one incoming chamber, at least one filtration zone, disposed between each of the at least one incoming chambers and the at least one corresponding effluent chamber, and a gel layer to contain tissue and/or cells.

[0011] The method of the present teachings for automatically growing tissue can include, but is not limited to including, selecting cells associated with the tissue, expanding the cells, creating at least one tissue bio-ink including the expanded cells, printing the at least one tissue bio-ink in at least one tissue growth medium mixture, growing the tissue from the printed at least one tissue bio-ink in the at least one tissue growth medium mixture, and maintaining viability of the tissue. The method can optionally include producing a protein associated with the tissue.

[0012] The method of the present teachings for regrowing at least one axon of a nervous system and for restoring lost connections in the nervous system can include, but is not limited to including, providing, in a tissue enclosure, mechanical loading for axonal stretch growth of the at least one axon in at least one tissue-engineered nerve graft. The step of providing mechanical loading can include, but is not limited to including, attaching at least one integrative neuron, including the at least one axon, of the at least one tissue-engineered nerve graft to at least one sled within the bioreactor system. The at least one integrative neuron can include a first end and a second end. The first end can attach with a first set of the at least one sled, and the second end can attach with a second set of the at least one sled. The step of providing mechanical loading can include drawing apart the attached first set and the attached second set with a pre-selected force, and maintaining, by a plurality of load cells attached to at least one of the first set and the second set, the pre-selected force within a pre-selected limit. The plurality of load cells can communicate with electromagnetically driven shafts that can engage with at least one of the first set and the second set. The pre-selected force can be maintained electromagnetically. The method for regrowing an axon can include adjusting current signals sent to the electromechanically driven shafts when the at least one tissue-engineered nerve graft reaches maturity. The method can optionally include detecting indicators of potential damage during stretching based on information collected by sensors operably coupled with the tissue enclosure. The sensors can optionally include at least one optical sensor and a microelectrode. The method can optionally include stimulating the at least one integrative neuron, and augmenting a rate of growth and minimizing breakage of the at least one axon based on an amount of nutrients provided in the tissue enclosure, growth factors and supplements provided, and an amount of waste products evacuated from the tissue enclosure.

[0013] The bioreactor system of the present teachings for axonal stretch growth of tissues can include, but is not limited to including, a plurality of sleds. Each of the plurality of sleds can be operably coupled with a movable shaft. A first set of the plurality of sleds can be engaged with a first end of a bundle of neurons, and a second set of the plurality of sleds can be engaged with a second end of the plurality of sleds. The system can include a plurality of load cells attached to the plurality of sleds, at least one sensor sensing movement of at least one of the plurality of sleds, and a bundle of neurons engaged on one end with a first set of the plurality of sleds. The bundle of neurons can be engaged on a second end with a second set of the plurality of sleds. The system can include a controller monitoring the at least one sensor. The controller can control the at least one sensor, the controller can control at least one environmental parameter in the bioreactor system, and the controller can command a pre-selected force to be applied to the bundle of neurons. The controller can monitor the pre-selected force, and maintain the pre-selected force within a pre-selected limit. The movable shaft can optionally be electromagnetically driven. The movement of the movable shaft can optionally be controlled by varying a current to the electromagnet.

[0014] The organ life support system for maintaining tissue of the present teachings can include, but is not limited to including, at least one incoming chamber receiving an incoming fluid, and at least one effluent chamber allowing a fluid outflow from the system. The at least one effluent chamber can be maintained at a pressure different from the at least one incoming chamber. The organ life support system can include at least one filtration zone disposed between each of the at least one incoming chambers and the at least one effluent chambers, and a medium/tissue chamber housing the tissue and growth media. The medium/tissue chamber can receive the incoming fluid from the at least one incoming chamber through the at least one filtration zone, and the medium/tissue chamber can enable fluid flow to at least one effluent chamber through the at least one filtration zone. The pressure within at least one effluent chamber is optionally lower than the pressure within the at least one incoming chamber. The difference in pressures can optionally be maintained by at least one pump. The at least one incoming chamber and the medium/tissue chamber can optionally be separated by one of the at least one filtration zones, and the medium/tissue chamber and the at least one effluent chamber can optionally be separated by one of the at least one filtration zones. The system can optionally include observation windows and sensors disposed within the at least one incoming chamber and the at least one effluent chamber. The at least one filtration zone can optionally include a membrane filter. The at least one pump can optionally include a fluid pressure pump and/or a fluid vacuum pump.

[0015] The tissue enclosure of the present teachings enabling creation, maintenance, and monitoring of tissue can include, but is not limited to including, a core including a cavity. The core can include at least one monitoring area and at least one opening into the cavity. One of the at least one openings can receive the tissue, and the core can accommodate at least one material ingress and at least one material egress. The tissue enclosure can include at least one filter assembly operably coupled with the core. The tissue can be confined within the cavity by the at least one filter assembly, the life of the tissue can be maintained at least by fluid flowing through the cavity between the at least one material ingress and the at least one material egress, and the tissue can be monitored through the at least one monitoring area.